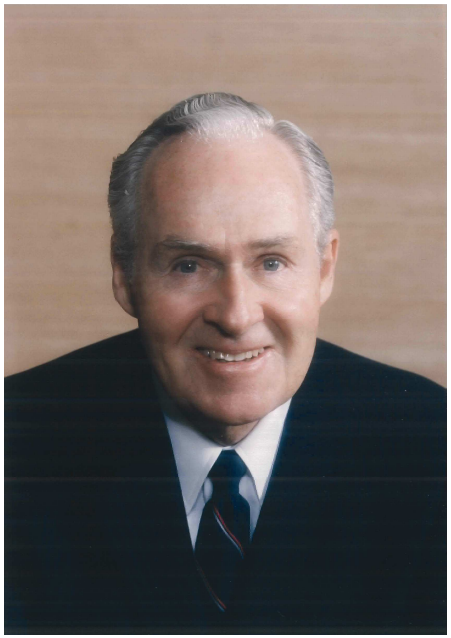
PERFECT POWER INSTITUTE

Empowering the Consumer

ACCELERATING INNOVATION AND INVESTMENT

Introduction

- Provide innovative performance metrics, design tools and ideas to help leaders and professionals dramatically improve system performance and U.S. competitiveness
- Programs
  - LEED type system for the grid
    - Professional and project certification
  - Collaborative Analysis and Benchmarking
    - Get the system in the room
    - Research - develop more and better ideas
    - Rapid prototyping – put ideas into action
  - Learning systems

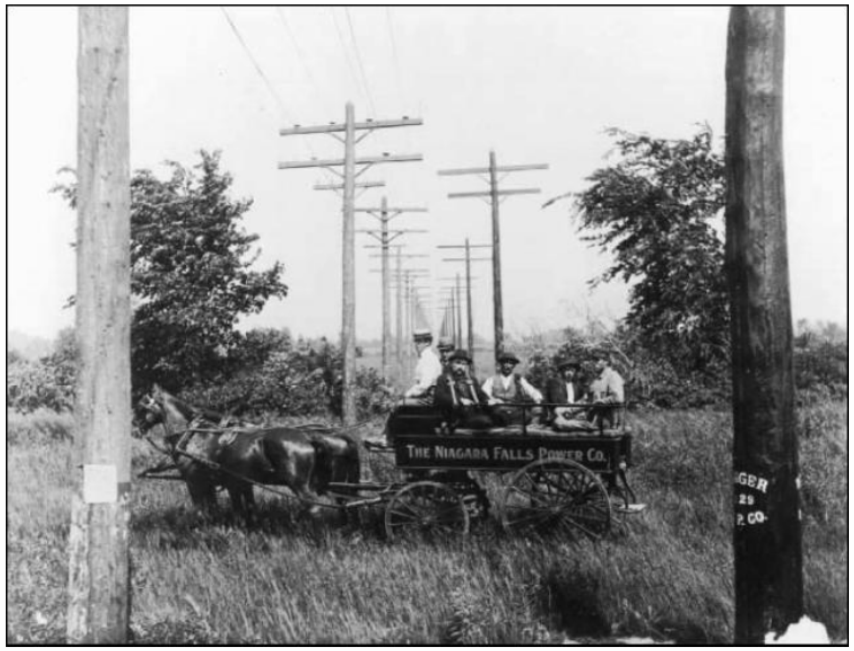


Over the past century, new technology has revolutionized our economy

Communications

Transportation

But the basic electricity grid design from the 1890s is largely unchanged



Niagara Falls, New York in 1895

Marion, Ohio in 2007

*"We need a **21st century electric grid for a 21st century economy**…we must have an efficient electricity infrastructure to compete in the global economy."*

-Secretary of Energy Steven Chu

US Generation 1990-2010

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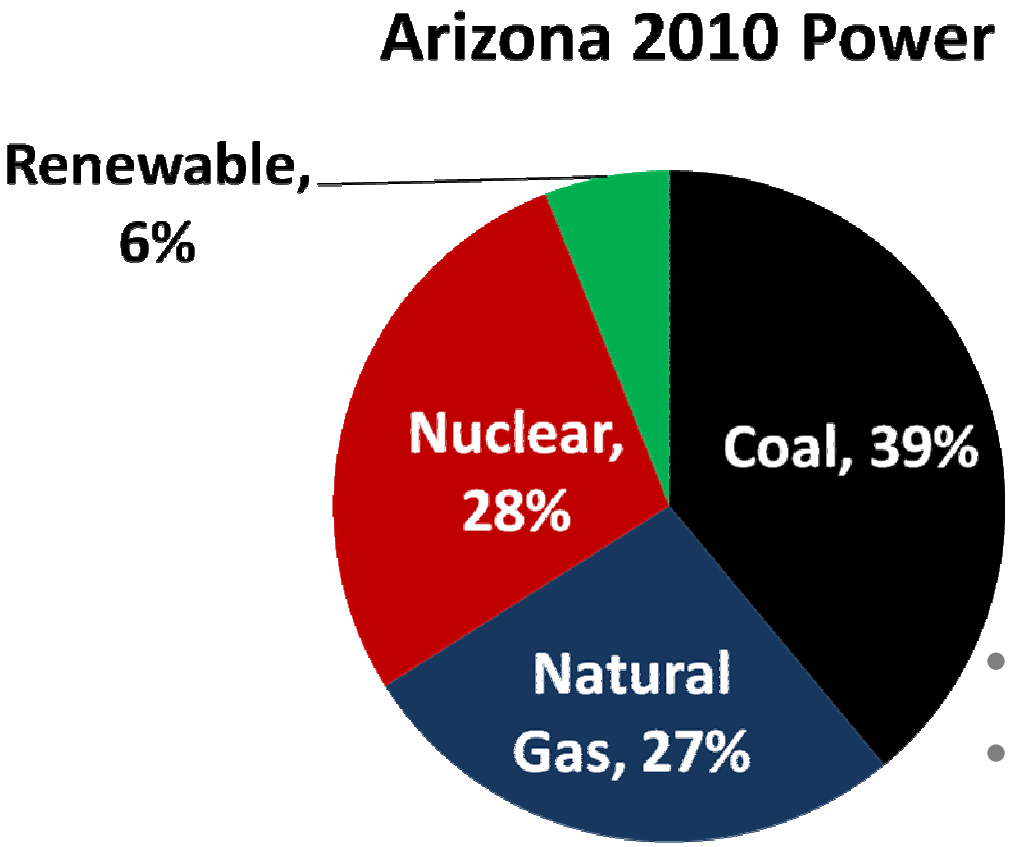
CO2e Increases by 400 million tons
Fossil fuel generation increases to 90%

	1990, MWh	2010, MWh	Delta, MWh	Carbon Delta, million tons
Coal	1,594,011,479	1,847,290,279	250,000,000	280
Petroleum	126,460,202	37,061,013	-90,000,000	-80
Natural Gas	372,765,154	987,697,234	600,000,000	200
Nuclear	576,861,678	806,968,301	230,000,000	
Hydroelectric	292,865,846	260,203,069	-33,000,000	
Wind	2,788,600	94,652,246	90,000,000	
Solar	367,087	1,212,182	850,000	
Wood/Bio	45,781,889	56,089,160	10,000,000	
Geothermal	15,434,271	17,807,482	2,400,000	
% Renewable	12%	10%		

Reference: EIA electricity data, http://www.eia.gov/electricity/data/state/

AZ Electricity Current State



- Carbon – 44 million mtons
- Sulfur Dioxide – 33,000 mtons
  - 180,000 lbs/day
- Nitrogen Oxide – 54,000 mtons
- Several tons of mercury and toxins

In Anticipation of Restructuring IPP's Build Massive CCCT Fleet in AZ

12,000MW of CCCT only 35% utilized, unused 65,000,000 MWh
7,000MW of IPP CCCT only 23% utilized, unused 40,000,000 MWh

2010 Source	~MW	~MWh	Utilization	2009 Δ
Coal	6,700	44,000,000	70%	+ 4 TWh
Hydroelectric	2,700	6,600,000	NA	NC
Natural Gas	15,000	30,000,000	23%	- 4 TWh
Nuclear	4,000	31,000,000	83%	NC

Reference: EPA eGRID 2007 and EIA electricity data,
http://www.eia.gov/electricity/data/state/

Shifting the Focus to Outcomes?

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Entity	Score 100 Max	Heat Rate (mmBTU /MWh)	Carbon Intensity (lb/MWh)	SOx	NOx	Water	Hydro, Wind, Biomass
MEA	83	3	300	0.05	0.05	48	73%
IIT	79	4	0	0	0	30	65%
ID	74	1	200	1.1	0.7	800	84%
SD	52	5	700	2.4	2.3	700	66%
CA	48	8	900	0.6	1.4	460	28%
MT	40	7.5	1,400	1.5	1.4	>500	40%
AZ	38	9	1,000	0.6	1.0	>400	6%
ND	18	11	1,800	6.6	3.0	>400	18%

Reference: EIA electricity data, http://www.eia.gov/electricity/data/state/ and Army Core power plant water consumption report.

Arizona Opportunity

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Sufficient existing CCCT to replace all of the existing coal gen Perfect Power Rating increases from ~38 to ~72

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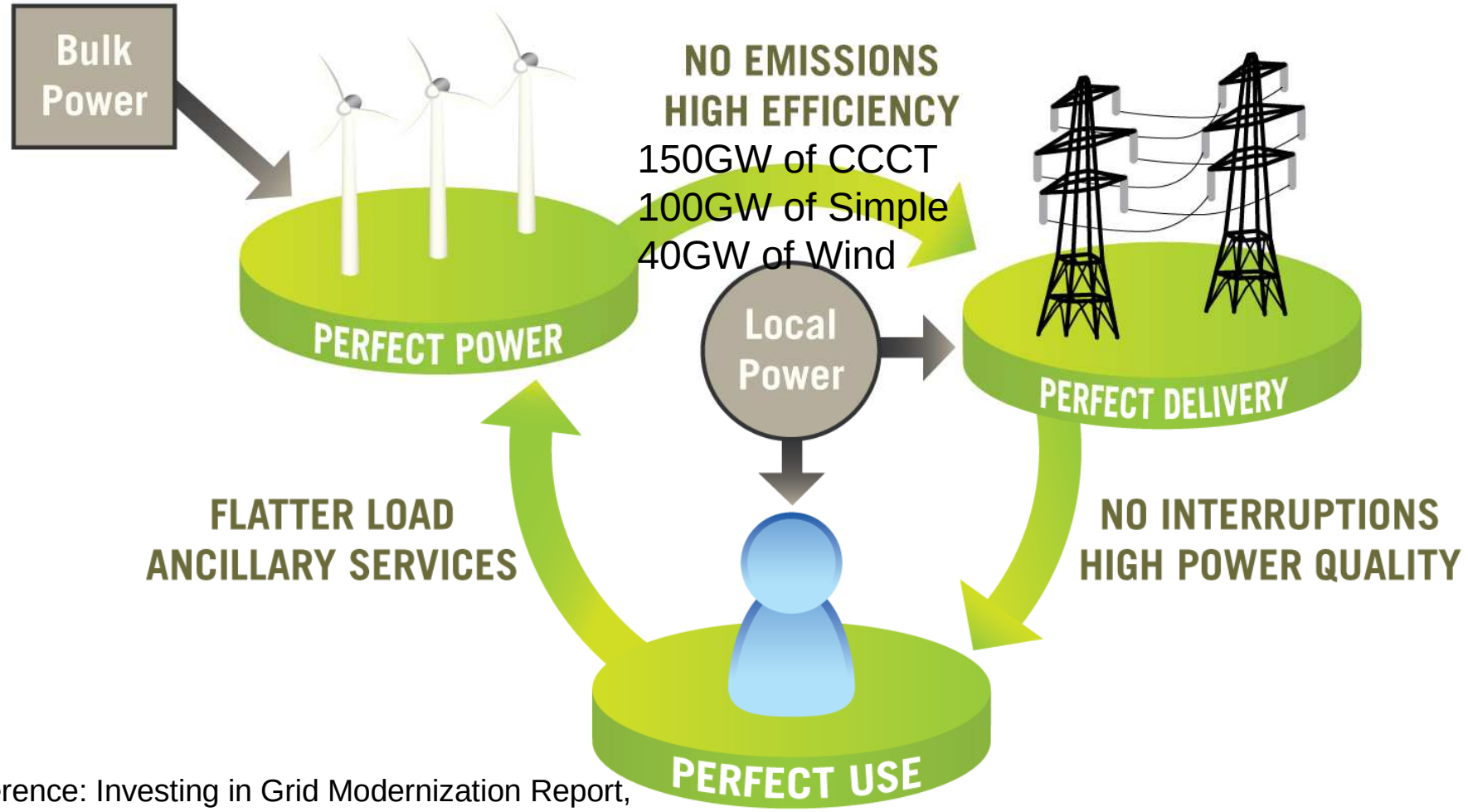
Source	Heat Rate (mmBTU/ MWh)	COe Intensity (lbs/MWh)	SOx (lbs/MWh)	NOx (lbs/MWh)	Water (gal/MWh)
AZ All	9	1,000	0.6	1	400+
AZ Coal	10.6	2,000	1.5	2.5	400+
AZ CCCT	7	680	~0	~0	150
Savings if coal were displaced by CCCT	.13 quads	26 million mt (60% reduction)	33,000 mt	57,000 mt	16 billion

Reference: EIA electricity data, http://www.eia.gov/electricity/data/state/

Systems Approach Gaining Leverage



Reference: Investing in Grid Modernization Report,
http://www.perfectpowerinstitute.org/sites/default/files/Investing%20in%20Grid%20Modernization.pdf
Annual Energy Outlook, 1999 and 2011

Electricity Supply
The Quadruple Plan

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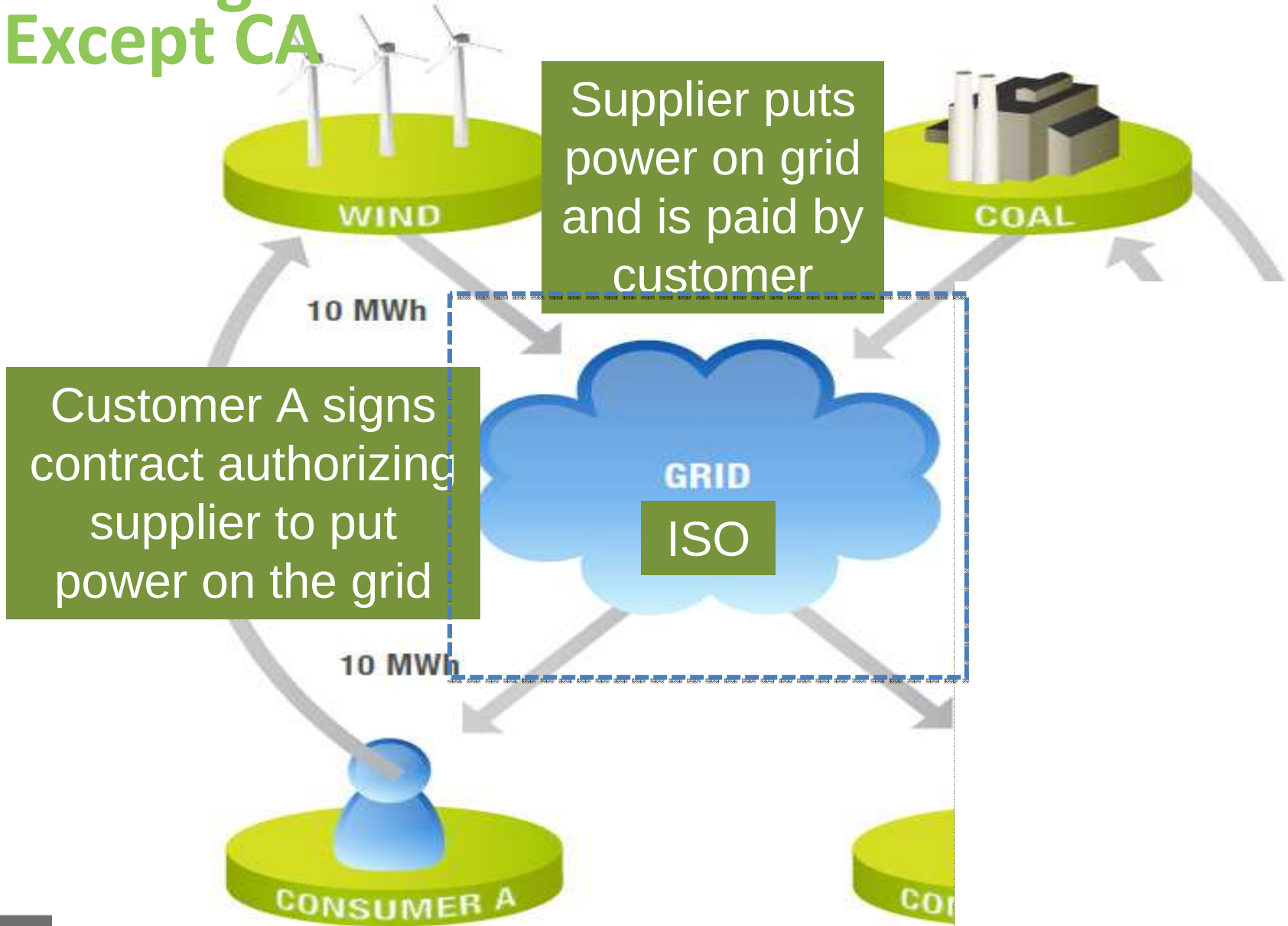
2010 Source	Total US	Electricity Supply Waste	Benchmark
Wasted Energy	100 quads	26 quads	Auto 20 quads
Carbon, mil mtons	5,400	2,200	Auto 1,900
Water		> 4 million ACRE-FEET	AZ 2 million for muni. and ind.
Solid Waste		40 million tons	
Sulfur		5 million stons	
Hg and HAP's		Significant	

Annual Energy Outlook 2011
http://en.wikipedia.org/wiki/Fly_ash

Pool-Co Electricity Markets Early 1990's UK Model

Bi-Lateral Electricity Markets Leveraged in all States Except CA



Restructuring Process Continuous Improvement

- Wholesale competition (bi-lateral)
- Retail competition
- Real-time and day-ahead pricing pools
- Ancillary Services
  - Demand response, capacity, voltage support, spinning reserve, frequency, efficiency as DR
- Customer side innovation
  - AMI, direct access to data, interconnect,

EMPOWER INNOVATOR TO ENABLE CONSUMER

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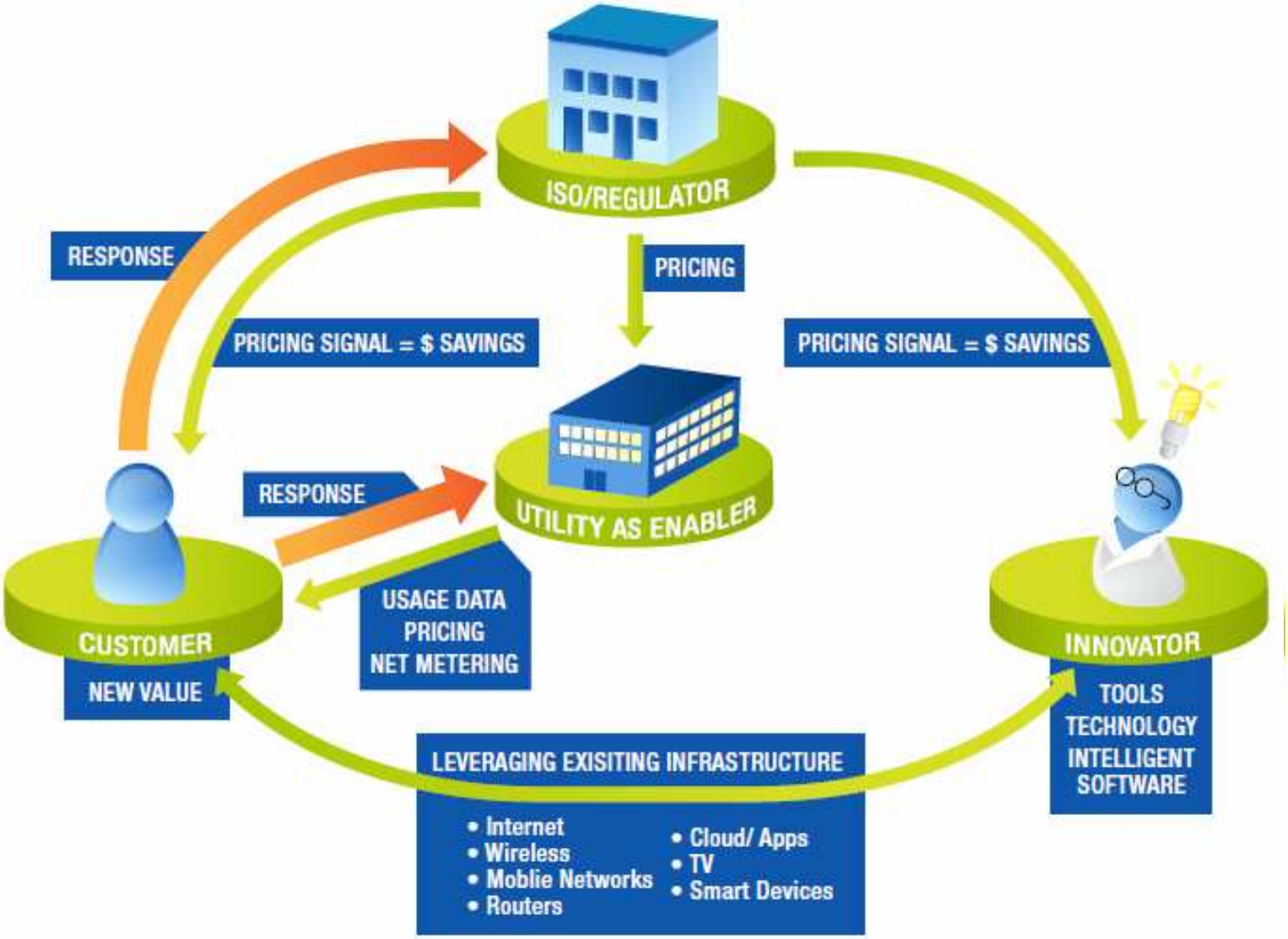
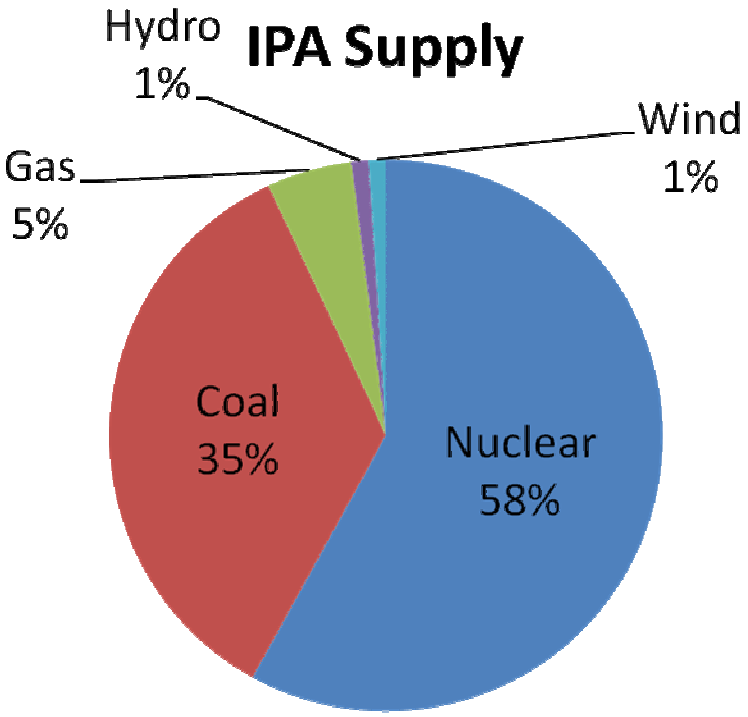
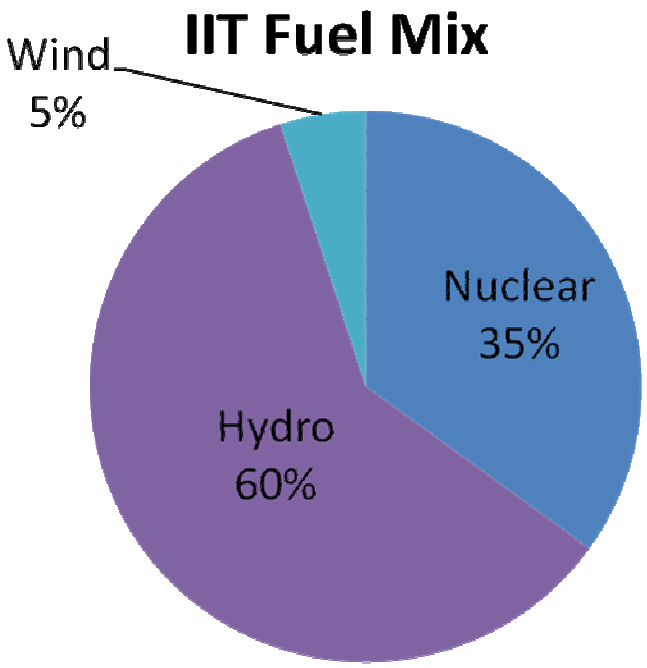


Unlocking Innovation and Investment

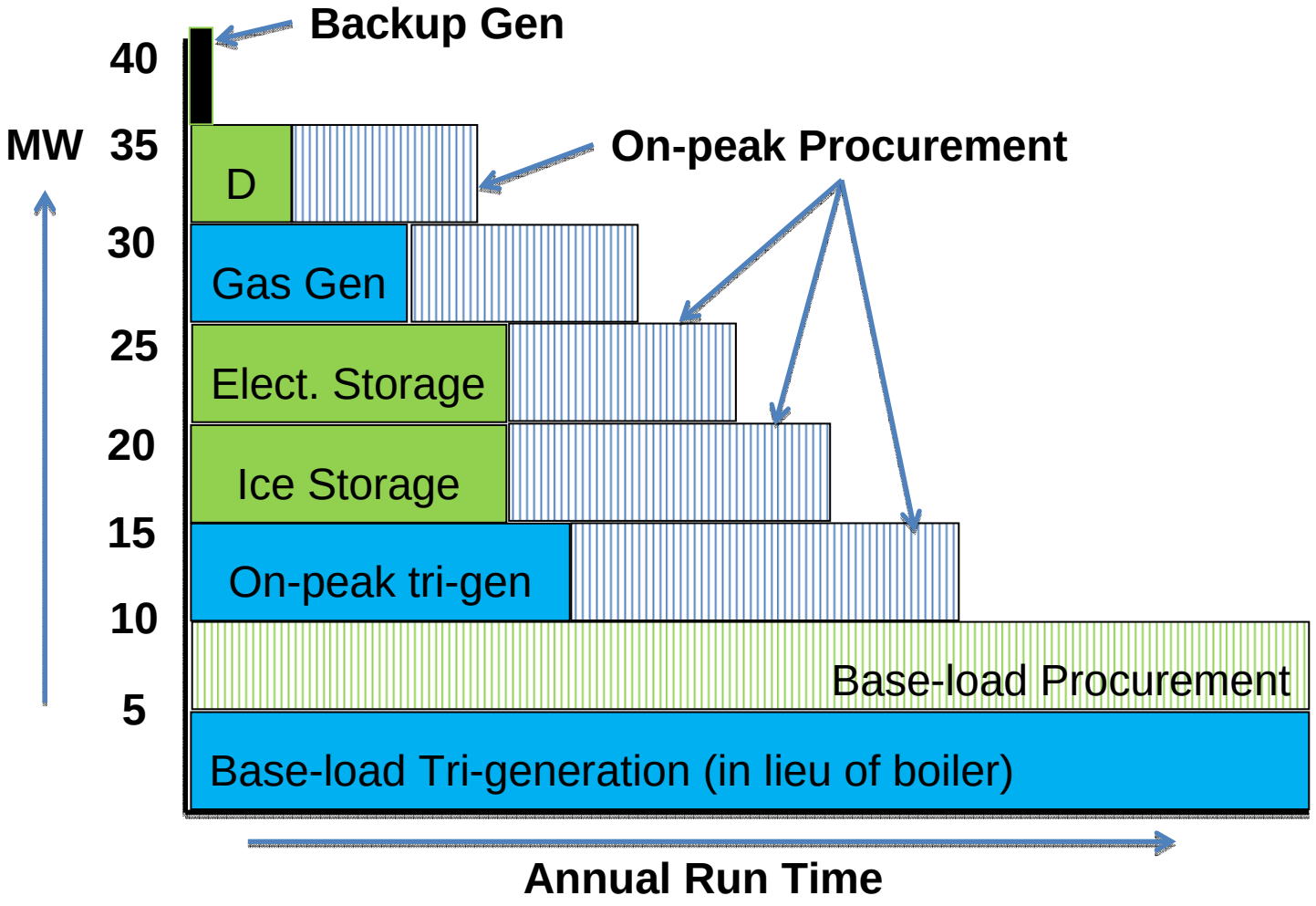
- Choice
- Price Transparency
  - AMI
  - Real-time/Day-ahead
  - Flat based on profile
  - Tiered
- Value Customer
  - DR, voltage support, & capacity payments
  - EE as capacity
- Interconnect
- Net-metering
  - Physical
  - Virtual
  - Feed-in in lieu of subsidy
- Community aggregation
- New regulatory framework

What is Perfect Supply?





University of Princeton Prototype Overview



AEP Establishes New Model

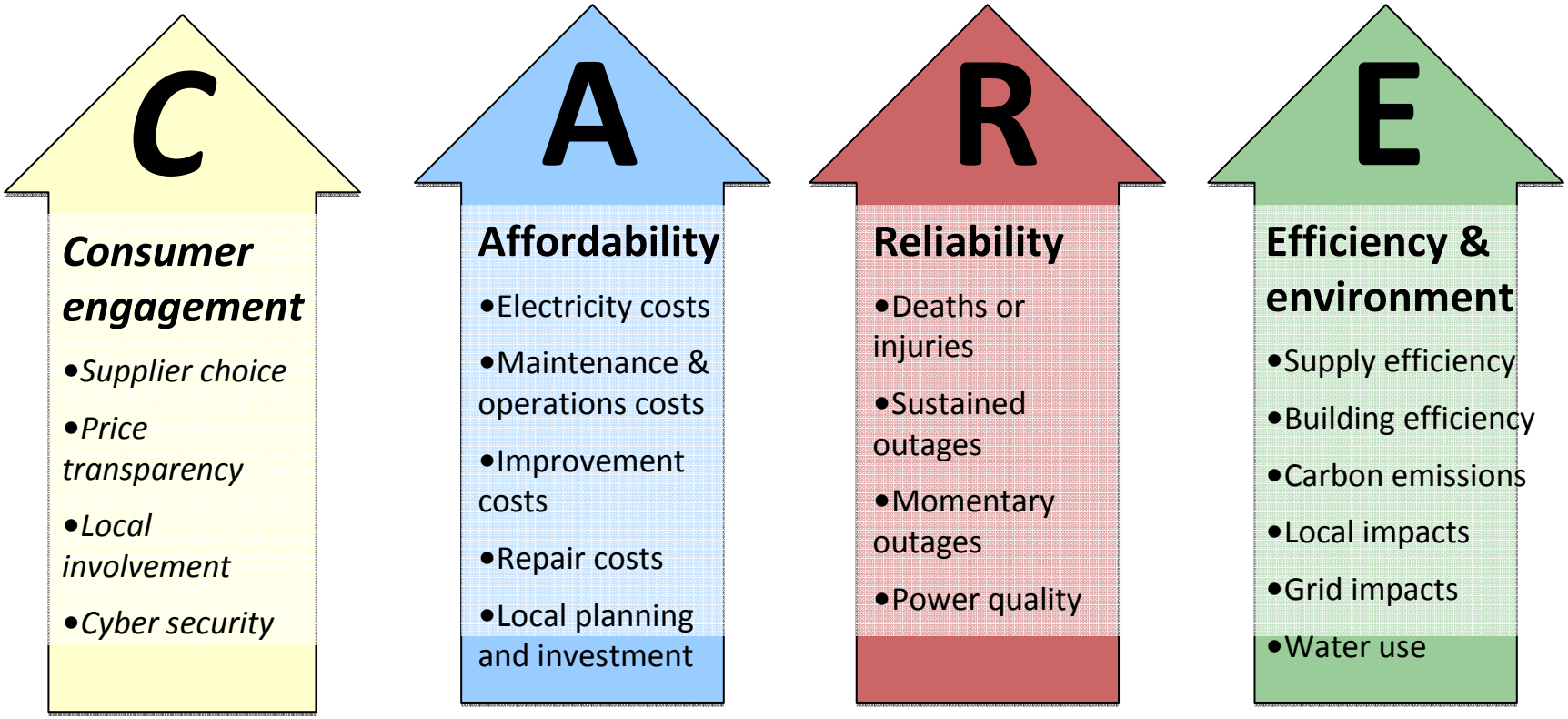
- Faced with the likelihood that AEP would not get cost recovery for coal plant environmental upgrades
- AEP proposes restructuring of its generation fleet in return for stranded asset recovery
- AZ Commission and APS could consider moving coal assets to a utility holding company with stranded recovery instead of paying for buyout and environmental upgrades

Recommendations

- Go slow - phased in restructuring
  - All new generation is procured from IPP via solicitations
- Go fast – immediate unbundling of utility generation assets and the opening of all markets
  - Develop an AZ restructuring model based on the best practices from PJM, NY, NE, and ERCOT ISO's
  - Arizona power agency modeled after Illinois
  - Coal generation assets are sold to utility subsidiary with stranded cost recovery for utility
  - Consumer protections
    - Cyber security, DOE Green Button
    - Retail supplier accreditation and ratings

PPI is Developing a LEED Type Rating System for the Grid

New Performance Assessment and Design System



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2012 Perfect Power Institute Program Activities

- V1 Perfect Power Seal of Approval Development
  - Currently developing technical committees
- Test sites and examples of outstanding performance
  - Supporting case studies
  - Gathering key data
    - Cost of poor performance
    - Benefits of investing in Sustainable Power
    - Benchmarking
- Education – Perfect Power Academy

Learn more at www.PerfectPowerInstitute.org